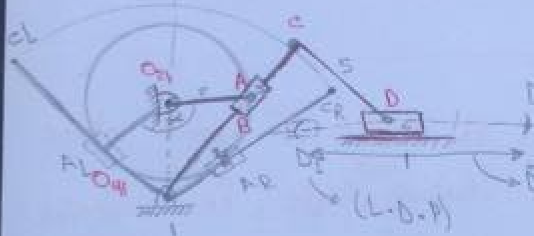
المحاضرة [٣] نظرية الآلات

21/10/2015

AMR M.Y

(a)

Quick - Return Mechanism (Q.R.M)



D_R — Right Dead Position (R.D.P)

D_L — (L.D.P)

$\overline{D_L D_R} \rightarrow$ (stroke)

$\theta°$ or θ^{rad} ← في الحركة الزاوية

$\hookrightarrow$ radain $= \frac{180}{\pi} = 57.23$

$\left(\omega \rightarrow \frac{d\theta}{dt}\right) \rightarrow$ degrees/s or radious/s $\Big\} \rightarrow (rad/s) = rad\, s^{-1} = s^{-1}$

$\left\{\begin{matrix}\text{Return stroke}\\ \text{displacement}\end{matrix}\right\}$ $\alpha = \frac{d\omega}{dt} = rad/s^2$ or $rad \cdot s^{-2} = s^{-2}$

$\left\{\begin{matrix}\text{cutting}\\ \text{work}\end{matrix}\right\}$ ω_w or $\omega_C \rightarrow \frac{\theta}{T} = \frac{360° - \alpha}{T_C}$

$$\boxed{\therefore T_C = \frac{360° - \alpha}{\omega_C}}$$

$\left\{\begin{matrix}\text{Return}\\ \text{time}\end{matrix}\right\}$ $\rightarrow \boxed{T_r = \frac{\alpha}{\omega_r}}$

$\left\{\begin{matrix}\text{Time}\\ \text{ratio}\end{matrix}\right\}$ $\rightarrow \boxed{\lambda = \frac{T_C}{T_r} = \frac{\frac{360 - \alpha}{\omega_C}}{\frac{\alpha}{\omega_r}}}$

Angular velocity of driver → Regular Motion

$n \rightarrow$ Const.

r.p.m

$\omega \rightarrow$ Const.

$\boxed{\omega_C = \omega_r}$

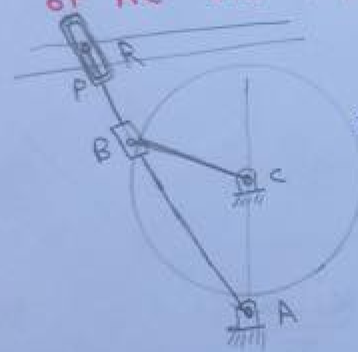
6

stroke : $D_R D_L$

* التحكم في طول المشوار ← عن طريق طول الـ Driver
أو عن طريق طول اللينك رقم 4

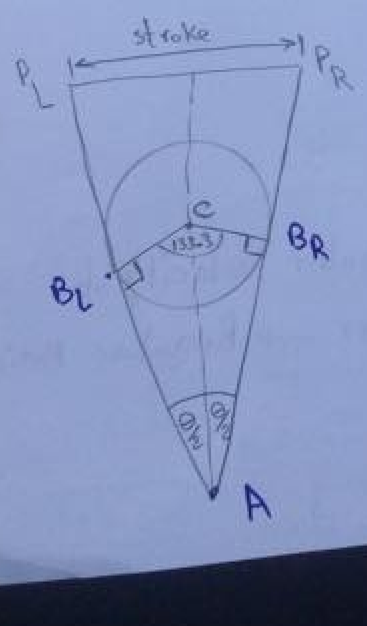
$$\boxed{\text{Mean velocity} = \omega}$$

Ex : 1 The shown figure shows the layout of a quick return mechanism of the oscillating link type, for a special purpose machine. The driving crank BC is (30 mm) long and time ratio of the working stroke to the return stroke is to be 1.7. If the length of the working stroke of R is (120 mm), Determine the dimensions of AC and AP.



Sol.

$$\lambda = 1.7 = \frac{360 - \alpha}{\alpha} \quad \therefore \alpha = 133.3^\circ$$



$$\theta = 360 - 180 - 133.3 = \text{------}$$

C

Ex: 2 The driving crank of quick return mechanism. show in fig. runs at uniform speed of 300 rpm. crank length is 7.5 cm, slotted lever length is 45 cm and the length of link 6 is 30 cm, find:

ⓐ The extreme position of the tool box, the time ratio and the stroke length.

ⓑ The mean value of cutting speed.

ⓒ The values of the angular speed ω_{41} of slotted lever دراع and the corresponding position.

ⓓ How to control the stroke of the tool box.

ⓔ The minimum length of the slot of lever.

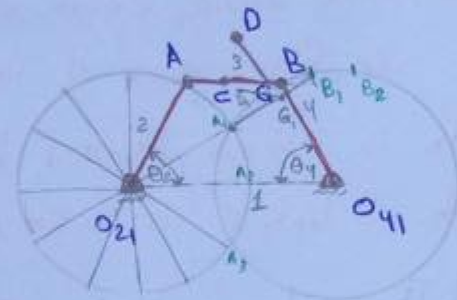
Sol.

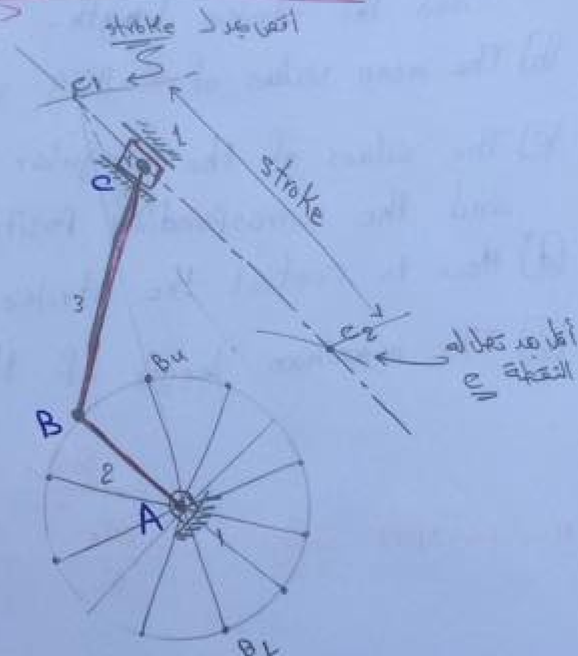
$$n = 300 \text{ rpm} \Longrightarrow \omega = \frac{2\pi n}{60} = \frac{2\pi * 300}{60} = \underline{10\,\pi} \ \text{rad/s}$$

d

Motion Analysis.

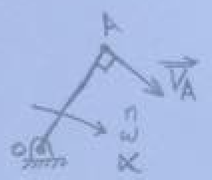
Four Bar Mechanism.





Displacement Analysis :-

+ Velocity and Acceleration Analysis



حركة انتقالية (E.A)	حركة الزاوية (G.A)
linear motion	angular motion
$V = V_o \pm at$	$\omega = \omega_o \pm \alpha t$
$S = V_o t \pm \frac{1}{2} a t^2$	$\theta = \omega_o t \pm \frac{1}{2} \alpha t^2$
$V^2 = V_o^2 \pm 2aS$	$\omega^2 = \omega_o^2 \pm 2\alpha\theta$

$$\boxed{\vec{V_A} = \vec{V_A} = \vec{V_{A_o}} = \omega_A * R = \omega_A * OA}$$

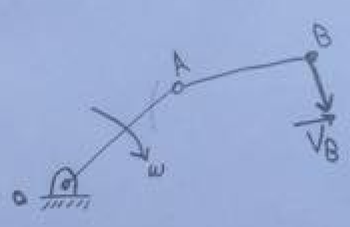
$\omega_A \downarrow \omega_2 \downarrow \omega_{21}$

$$V = \omega \cdot R$$

$$\omega = \frac{2\pi n}{60}$$

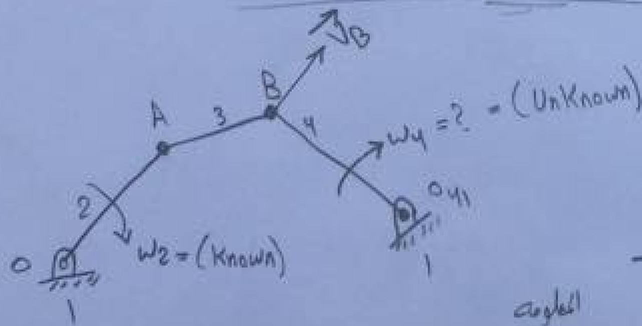
---

absolute	Relative
$\vec{V_A}$	$\vec{V_{BA}}$



$$\vec{V_B} = \vec{V_A} + \vec{V_{BA}}$$

Direction (D)   (M+D)   Direction (D)



مضلع السرعات

Velocities Polygon
Diagram
chart
scheme

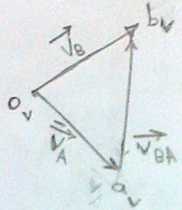
المطلوب $\vec{V_A}$ ، $\vec{V_B}$ ، $\vec{V_{BA}}$

F

By scaling (scale) :- $1\,cm \equiv \text{---}\ m/s$

رسم مضلع السرعات

① اختيار نقطة بدء رسم المضلع بطريقة مناسبة.
② اختيار مقياس رسم مناسب.



$$\vec{V}_B = \vec{V}_A + \vec{V}_{BA}$$

From fig $\vec{V}_B = b_v o_{v_1} * \text{scale}$

$\vec{V}_{BA} = a_v b_v * \text{scale}$

$$w_4 = \frac{\vec{V}_B}{o_{4_1}B}$$

$$w_3 = \frac{\vec{V}_{BA}}{AB}$$

$\vec{V}_A = w_2 * O_2A \begin{pmatrix} M // \\ + \\ D \perp O_2A \end{pmatrix}$

عمودي على OA من نقطة A في اتجاه w_2

$\vec{V}_B = \begin{pmatrix} \text{Direction only} \\ \text{Known} \end{pmatrix}$

$\vec{V}_{BA} = (\text{Direction only})$

$$w = \frac{2\pi n}{60} \longrightarrow n = \frac{60w}{2\pi} = \frac{30w}{\pi}$$

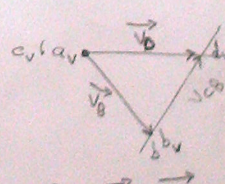
* slider _ Crank Mechanism (s.c.M)

suitable scale $1\,cm = \text{---}\ cm/s$

AB
Bc — Direction of M.

Sol.

$$\vec{V}_B = w_2 \times AB \quad cm/s$$



$$\vec{V}_c = \vec{V}_B + \vec{V}_{CB}$$

$\vec{V}_c = a_v d_v * \text{scale}$ cm/s
$= w_4 *$

$\vec{V}_{CB} = b_v c_v * \text{scale}$
$= w_3 * BC$